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Agilent Technologies
11713A Attenuator/Switch Driver
Operating and Service Manual

Part Number: 11713-90023

Printed in USA

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New Zealand (tel) 0 800 738 378 (fax) (+64) 4 495 8950	**Japan** (tel) (+81) 426 56 7832 (fax) (+81) 426 56 7840	**Australia** (tel) 1 800 629 485 (fax) (+61) 3 9210 5947	

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Singapore	1-800-375-8100	(65) 836-0252
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Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

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Safety and Regulatory Information

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. This product has been designed and tested in accordance with international standards.

WARNING

The WARNING notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUTION

The CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

Instrument Markings

	When you see this symbol on your instrument, you should refer to the instruments instruction manual for important information.
	This symbol indicates hazardous voltages.
	This symbol indicates that the instrument requires alternating current (ac) input.
	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
	The C-Tick mark is a registered trademark of the Australian Spectrum Management Community.
	The CSA mark is a registered trademark of the Canadian Standards Association.
1SM1-A	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).
	This symbol indicates that the power line switch is ON.
	This symbol indicates that the power line switch is in STANDBY position.

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This symbol indicates that the power line switch is OFF

Safety Earth Ground

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before Applying Power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Compliance With German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrerordnung-3.GSGV Deutschland).

Acoustic Noise Emmision/Gerauschemission	
LpA <70 dB	LpA <70 dB
Operator position	am Arbeitsplatz
Normal position	normaler Betrieb
per ISO 7779	nach DIN 45635 t.19

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General Safety Considerations

WARNING

- **This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied In a safe condition. The Instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product In a safe condition.**
- **The ON//OFF switch or the detachable power cord is the instrument disconnecting device. It disconnects the main circuits from the main supply before other parts of the instrument. Alternately, an externally installed switch of circuit breaker, which is readily identifiable and is easily reached by the operator, may be used as a disconnecting device.**

WARNING

- **This product is designed for use in Installation Category and Pollution Degree 2 per IEC 1010 and 664 respectively.**
- **Install the instrument according to the enclosure protection provided. This instrument protects against finger access to hazardous parts within the enclosure. The Instrument does not protect against the ingress of water.**
- **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**
- **When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4°C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 wafts forced convection must be used.**

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DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name: Agilent Technologies, Inc.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the product

Product Name: Attenuator/Switch Driver

Model Number: 11713A

Product Options: This declaration covers all options of the above product.

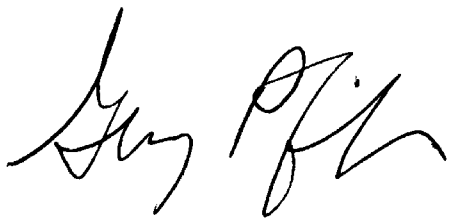
Conform to the following product specifications:

EMC: IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998

Standard	Limit
CISPR 11:1990 / EN 55011-1991	Group 1, Class A
IEC 61000-4-2:1995+A1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80 - 1000 MHz
IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV sig., 1 kV power
IEC 61000-4-5:1995 / EN 61000-4-5:1996	0.5 kV L-L, 1 kV L-G
IEC 61000-4-6:1996 / EN 61000-4-6:1998	3 V, 0.15 – 80 MHz
IEC 61000-4-11:1994 / EN 61000-4-11:1998	1 cycle, 100%

Safety: IEC 61010-1:1990 + A1:1992 + A2:1995 / EN 61010-1:1993 +A2:1995
CAN/CSA-C22.2 No. 1010.1-92

Supplementary Information:
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly.



Santa Rosa, CA, USA 14 May 2001

Greg Pfeiffer/Quality Engineering Manager

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Typeface Conventions

Italics

- Used to emphasize important information:
  Use this software *only* with the xxxxxX system.
- Used for the title of a publication:
  Refer to the *xxxxX, System-Level User's Guide*
- Used to indicate a variable:
  Type `LOAD BIN` *filename*.

`Instrument Display`

- Used to show on-screen prompts and messages that you will see on the display of an instrument:
  The xxxxxX will display the message **`CAL1 SAVED.`**

[Keycap]

- Used for labeled keys on the front panel of an instrument or on a computer keyboard:
  Press **[Return]**.

{Softkey}

- Used for simulated keys that appear on an instrument display:
  Press {Prior Menu}.

`User Entry`

- Used to indicate text that you will enter using the computer keyboard; text shown in this typeface must be typed *exactly* as printed:
  Type `LOAD PARMFILE`
- Used for examples of programming code:
  `#endif / / ifndef NO CLASS`
- Used for a subdirectory name or file path:
  Edit the file `usr/1oca1/bin/samp1e.txt`

`Path Name`

Computer Display

- Used to show messages, prompts, and window labels that appear on a computer monitor:
  The **Edit Parameters** window will appear on the screen.
- Used for menus, lists, dialog boxes, and button boxes on a computer monitor from which you make selections using the mouse or keyboard:
  Double-click **EXIT** to quit the program.

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1 Agilent Technologies 11713A Attenuator/Switch Driver

Overview

In this chapter you will find:

- Function, features, and capabilities of the 11713A attenuator/switch driver
- Compatible Agilent Technologies switches and attenuators

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Overview

The 11713A attenuator/switch driver is an GPIB compatible instrument designed to provide control of up to two four-section programmable step attenuators and two microwave coaxial switches.

Features

- Instrument control is accomplished manually from front panel pushbuttons or automatically over the GPIB interface bus.
- Programing via the GPIB can be accomplished in simple one line statements.
- The attenuator/switch driver features front panel status monitoring and a self-contained power supply with current limiting.
- The instrument includes solenoid arc suppression diodes and has common terminal supplies of +24 Vdc.
- Connections are made at the rear panel to the ten pairs of current sinking transistors
    - ❍ Five contact pairs per set are present at each rear panel multi-pin plug. This plug mates with the attenuator drive cable.
    - ❍ The remaining two contact pairs are connected to the banana jacks mounted on the rear panel. The banana jacks are available for driving the coaxial switches or for optional applications.
    - ❍ Each pair of contacts is individually programmable via GPIB or from the front panel pushbutton.
    - ❍ The contact pair status is indicated by the front panel LEDs in the appropriate pushbutton
    - ❍ The contact pairs 9 and 0 can be used to switch between one of two loads or to reverse the current through a single load.

Options

The Option 907 front handle kit contains front panel handles that can be added to the driver cabinet.

The Option 908 rack adapter kit contains the flange and hardware for mounting the driver in a standard rack of 48.3 cm (19 inches).

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Compatible Attenuators and Switches

The 11713A attenuator/switch driver is designed to drive the following Agilent Technologies attenuators and switches. If you are using attenuators and switches made by another company, check their switching characteristics against those specified in Chapter 3, "Specifications".

Table 1-1 Compatible Agilent Technologies Switches

Agilent Model Number	Description
8761B	SPDT
8762,B,C,F (3331A,B,C)	Terminated SPDT
8763A,B,C (33312A,B,C)	1-port Terminated SP3T
8764A,B,C (33313A,B,C)	Unterminated SP4T
8765A,B,C,D,F Opt 024 and 100(33314A,B,D)	Unterminated SPDT
8766K (33366K)	Unterminated SP3T
8767K (33367K)	Unterminated SP4T
8768K (33368K)	Unterminated SP5T
8769K (33369K)	Unterminated SP6T
87104A,B, C Option 100	Terminated SP4T
87106A,B,C Option 100	Terminated SP6T
87204A,B,C Option 100	Terminated SP4T
87206A,B,C Option 100	Terminated SP6T
87222C,D,E Option 100[a]	2P2T Transfer
87406B Option 100	4-port Matrix
87606B Option 1006	6-port Matrix

a. See caution on page 2-7.

Table 1-2 Compatible Agilent Technologies Attenuators

Agilent Model Number	Description
8494G,H (33320G,H)	11 dB, 1 dB steps
8495G,H,K (33321 G,H,K)	70 dB, 10 dB steps
8496G,H (33322G,H)	110 dB, 10 dB steps
8497K (33323K)	90 dB, 10 dB steps
84904K,L (33324K,L)	11 dB, 1 dB steps
84906K,L (33326K,L	90 dB, 10 dB steps
84907K,L (33327K,L)	70 dB, 10 dB steps

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Connecting Accessories

Table 1-3 lists accessories that are available for the 11713A attenuator/switch driver. Supplied accessories include two dual Viking connector cables, 12-pin conductor, 60 inches long, and a line power cable. Refer to "Replaceable Parts".

Table 1-3 Available Accessories

Accessories Available But Not Supplied	
Interconnect kit (Type-N connectors)[a]	Agilent 11716A
Interconnect kit (7-mm connectors)[a]	Agilent 11716B
Interconnect kit (SMA connectors)[a]	Agilent 11716C
Attenuator/switch driver rear cord wrap kit[b]	Agilent 5062-3995
Viking connector to four ribbon cables to connect up to four switches	Agilent 11761A
Viking connector to 10-pin DIP connector, 60 inches long	Agilent 11764B
9-Pin conductor cable, to Viking connector (for five switches), 60 inches long.	8120-2178
12-Pin conductor cable, bare wire to Viking connector (for five switches, 60 inches long.	5061-0969

a. Order this kit to connect two programmable step attenuators in series.
b. Order this kit to set the driver on the rear panel for bench operation.

Recommended Test Equipment

Recommended test equipment for verifying performance and for troubleshooting the 11713A attenuator/switch driver is given in Table 4-1.

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2 Installing the Agilent Technologies 11713A Attenuator/Switch Driver

Overview

In this chapter you will learn about:

- How to unpack and check your instrument
- How to contact Agilent Technologies for service
- Operating requirements for the attenuator/switch driver
- How to set the GPIB address of your instrument
- How to connect to switches, attenuators, and relays

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Initial Inspection

1. Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment. If the shipping container or cushioning material is damaged, the contents should be checked both mechanically and electrically.
2. If the contents are damaged or defective, contact your nearest Agilent Technologies Service and Support Office. Refer to the Service and Support information in the front matter of this manual. Agilent Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier's inspection.
3. If you are returning your instrument for service, repackaging the attenuator/switch driver requires original shipping containers and materials or their equivalents. Agilent Technologies can provide packaging materials identical to the original materials. Refer to "Service and Support" on page v for the Agilent Technologies nearest you.

Environmental Limitations

4. Ensure that you meet the environmental limitations for storage and shipment:

Temperature	-55 to 75 °C
Humidity	< 90% relative
Altitude	< 15,300 meters (50,000 feet)

Preparing for use

Bench Operation

5. For bench operation, supplied equipment includes:
   - ❍ plastic feet shaped to assure self-alignment of the instruments when stacked
   - ❍ fold-away tilt stands to raise the front of the instrument for easier viewing of the control panel

If the driver is to be used in a position that requires setting it on the rear panel, a kit is available (refer to Table 1-3) that includes feet with mounting screws.

Rack Mounting

6. For rack mounting the instrument, use the rack-adapter kit half-module. (Refer to Table 1-3).

   To install the kit:
   - ❍ Remove the feet and tilt stands.
   - ❍ Remove the side trim strips.
   - ❍ Attach the rack mount flange and flange adapter.

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Verifying Requirements

7. Verify that you meet the following requirements.

   ❑ Power source

      ❍ 100 to 120 volts (+5%, –10%) from 48 to 440 Hz

      ❍ 220 to 240 volts (+5%, –10%) from 48 to 66 Hz, single phase.

   ❑ Power consumption

      ❍ 80 VA max

CAUTION Before the instrument is switched on, it must be set to the voltage of the power source or damage to the instrument may result. Refer to Figure 2-1.

WARNING **If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole power source.**

   ❑ Power Cable

   In accordance with international safety standards, a three-wire power cable is provided with this instrument. When it is connected to an appropriate ac power receptacle, the cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of origin.

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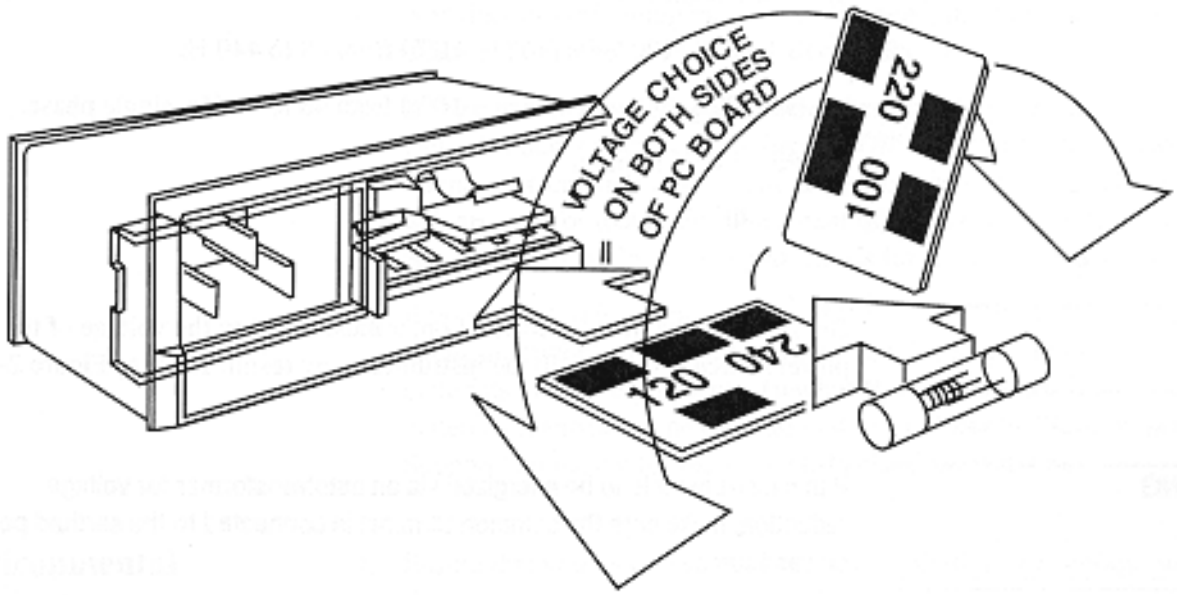
Figure 2-1 Line Voltage Selection



WARNING **To avoid the possibility of hazardous electrical shock, do not operate this Instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz (leakage currents at these line settings may exceed 3.5 mA).**

❑ Line Voltage and Fuse Selection

a. Open the cover door of the line power module. Push the fuse-pull lever to the left and remove the fuse. (Refer to Figure 2-1.)

b. Pull out the voltage selector PC board. Position the board so that the voltage nearest the actual fine voltage level is on the top-left side of the board.

c. Push the board firmly into the module slot.

d. Push the fuse-pull back into normal right-hand position.

e. Check that the fuse is the correct rating and type for the input ac line voltage. Fuse ratings for line voltages are indicated below the power module.

f. Insert the fuse into the holder.

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GPIB Addressing

8. Use the five-bit address switches located on the rear panel of the instrument to change the GPIB address.

   - The 11713A has a factory preset address of decimal 28. The switch labeled with a one is the least significant bit.
   - There are 32 possible addresses. Addresses 0 and 31 are typically reserved for GPIB functions and should not be used. IEE-488.1 limits the number of addressable elements (instruments) to 16.

Figure 2-2 GPIB Address Selection

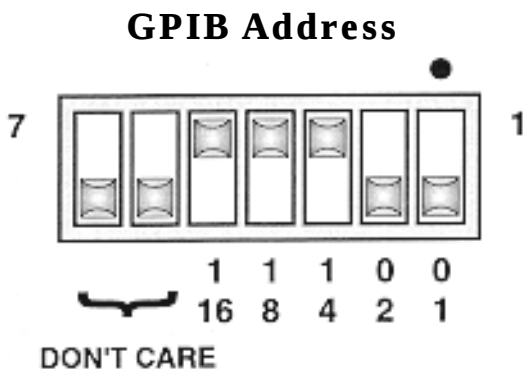

Table 2-1 ASCII Address Codes to Decimal Equivalents

ASCII Address Codes - LISTEN	Decimal Equivalents	ASCII Address Codes - LISTEN	Decimal Equivalents
SP	00	0	16
!	01	1	17
“	02	2	18
#	03	3	19
$	04	4	20
%	05	5	21
&	06	6	22
‘	07	7	23
(	08	8	24
)	09	9	25
*	10	:	26
+	11	;	27
,	12	<	28
-	13	=	29
.	14	>	30
/	15	?	31

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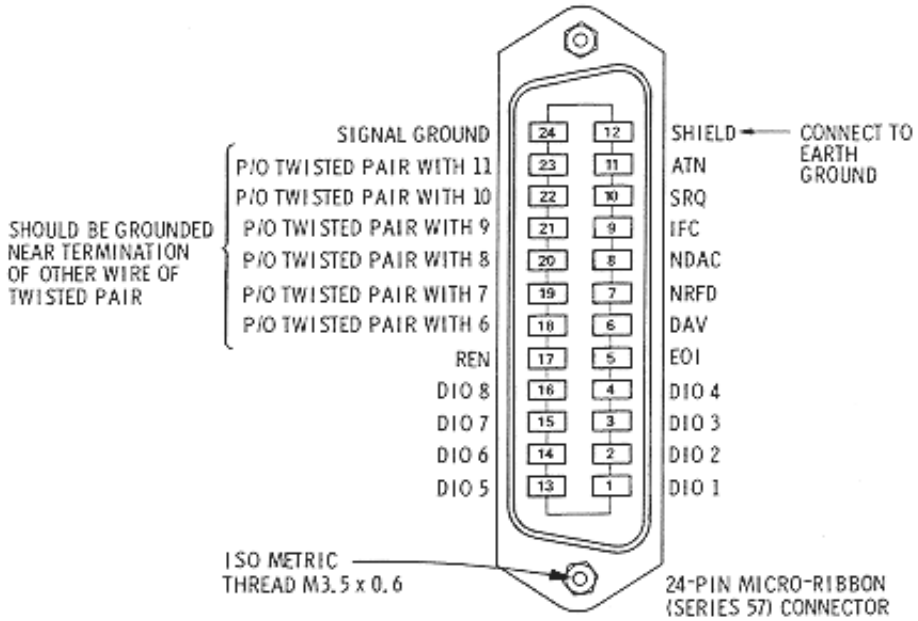
Mating Connectors

❑ Mating connectors used with the driver are the 24-pin GPIB male, the 12-pin Viking Industries connector, and the banana type male.

Figure 2-3 provides interconnection data for the General Purpose Interface Bus.

Figure 2-3 General Purpose Interface Bus Connection



Logic levels	The interface bus logic levels are TTL compatible, that is, the true (1) state is 0.0 to +0.4 Vdc and the false (0) state is +2.5 to +5.0 Vdc.
Programming and Output data format	Refer to Chapter 6, "Remote Operation".
Mating connector	Agilent 1251-0293
Mating cables available[1]	Agilent 10833A, 1 meter (3.3 ft.), Agilent 10833B, 2 meters (6.6 ft.) Agilent 10833C, 4 meters (13.2 ft.), Agilent 10833D, 0.5 meter (1.6 ft.)

CAUTION The maximum accumulative length of connecting cable for an interface bus system is 20 meters (65.5 ft.)

A general purpose interface bus system may contain no more than 2 meter (6.6 ft.) of connecting cable per instrument.

1. The Agilent 10834A adapter is required with these cables to provide additional clearance for the cable connections.

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Connecting to Attenuators and Switches

❑ Use the two plug-in drive cables supplied with the driver to connect to Attenuators and the multi-pin plugs on the rear panel.

These attenuator cables have 12-pin connectors that may not be usable on some equipment. In these instances, the cable may be modified by removing a connector. A 9-wire cable with only one connector is also available. (Refer to Table 1-3.)

Table 2-2 describes the cable wire colors/connector pin numbers and corresponding status of the front panel pushbutton indicators.

To drive a simple non-latching relay, only one wire in a pair needs to be used for the ground. Refer to Figure 2-7 for a typical relay-driving schematic.

CAUTION Do not drive the 87222C/D/E using the S9 or S0 outputs from either the banana plug outputs, or from pins 3 or 4 within the Atten X and Atten Y Viking sockets, both located on the rear panel of the 11713A.

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Table 2-2 Attenuator Cable Connector Pin Numbers and Wire Color Codes

Front Panel Pushbuttons [a] ATTENUATOR X, Y, and SWITCHES			Rear Panel connectors ATTEN X or Y, and Attenuator Cable	
Pushbutton Number		**Pushbutton LEDs**	**Pin Numbers**	**Attenuator Cable Wire Color Code**
			1	Red (24 Vdc)
			2	White/Brown (Gnd)
SWITCHES			Connect to S9 and S0 outputs	
9		ON	ATTEN X 3(S9-A)	Gray
9		OFF	ATTEN X 4(S9-B0	White/Red
0		ON	ATTEN Y 3 (S0-A)	Grey
0		OFF	ATTEN Y 4 (S0-B)	White/Red
ATTENUATORS				
X	Y			
1	5	OFF	5	Violet
		ON	6	Yellow
2	6	OFF	7	Black
		ON	8	Green
3	7	OFF	9	Orange
		ON	10	Blue
4	8	OFF	11	Brown
		ON	12	White

a. The ON/OFF status of the pushbutton lamps indicates which cable wire or pin on the rear panel connector is grounded.For example, if ATTENUATOR X pushbutton 3 is illuminated, pin 10 of the ATTEN X connector (blue wire of the cable) is grounded and pin 9 floats at a high impedance.

For the SWITCHES, if pin 3 is grounded (lamp on), pin 4 is connected to +24 V.

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Driving Additional Coaxial Switches

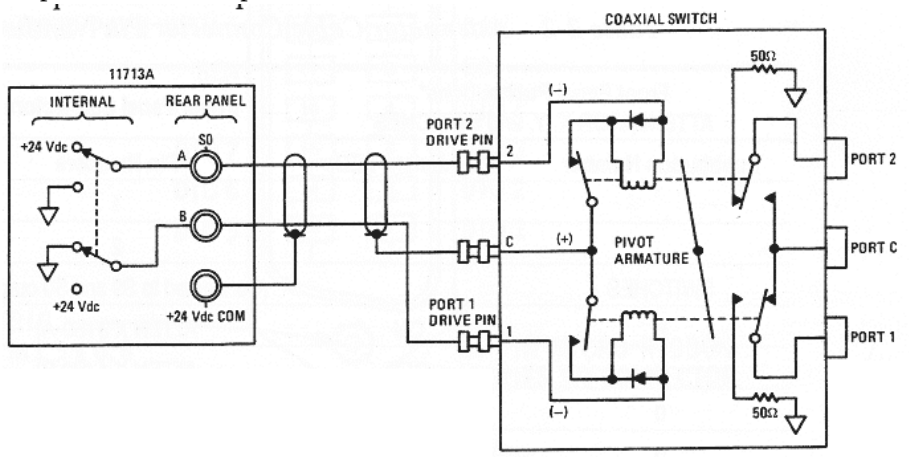
❑ Make switch connections to S0 outputs, S9 outputs, or to rear panel ATTEN X output or ATTEN Y output.

Figure 2-4 shows the rear panel connections to S0 outputs and the GPIB command necessary to change the position of Agilent 8762 or 8765 series coaxial switches. (For GPIB command usage, refer to "Data Message Input Format")

Connections to Agilent 8762 or 8765 series coaxial switches can also be made to the ATTEN X output or ATTEN Y output (refer to Figure 2-6 for connections/pin numbers). Control can be extended to four, eight, or 10 switches if S0 and S9 outputs are also used.

Figure 2-4 Connections for Coaxial Switches

❑ GPIB command "B0" connects port C and port 1 and turns the front panel LED for pushbutton 0 OFF.



❑ GPIB command "A0" connects port C and port 2 and turns the front panel LED for pushbutton 0 ON.

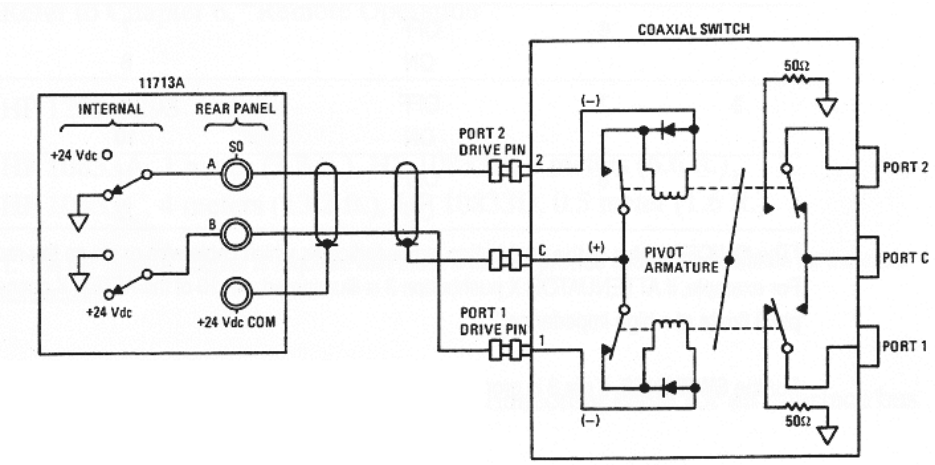


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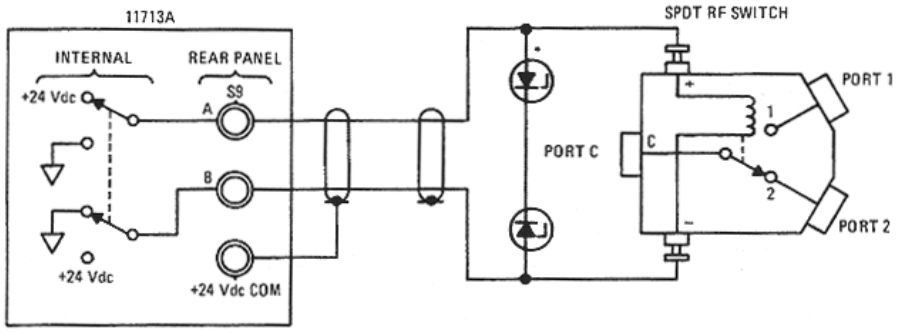
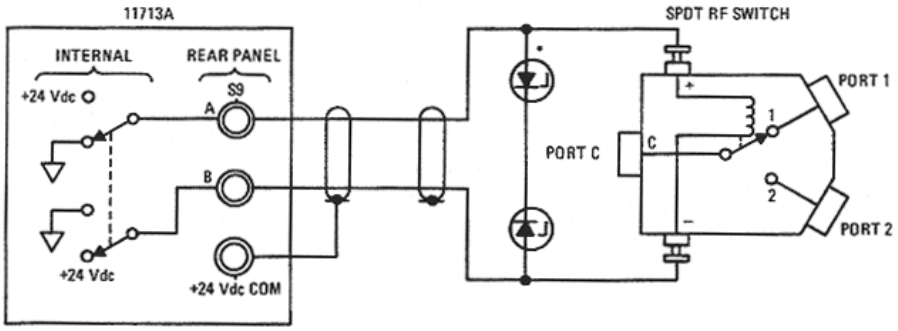
Figure 2-5 shows the rear panel connections and the GPIB command necessary to change the position of Agilent 8761B SPDT RF switches. (For GPIB command usage, refer to "Data Message Input Format" on page 6-3.)

Figure 2-5 Connections for Agilent 8761B SPDT Switches

❏ GPIB command "B9" connects port C and port 2 and turns the front panel LED for pushbutton 9 OFF.



❏ GPIB command “A9” connects port C and port 1 and turns the front panel LED for pushbutton 9 ON.



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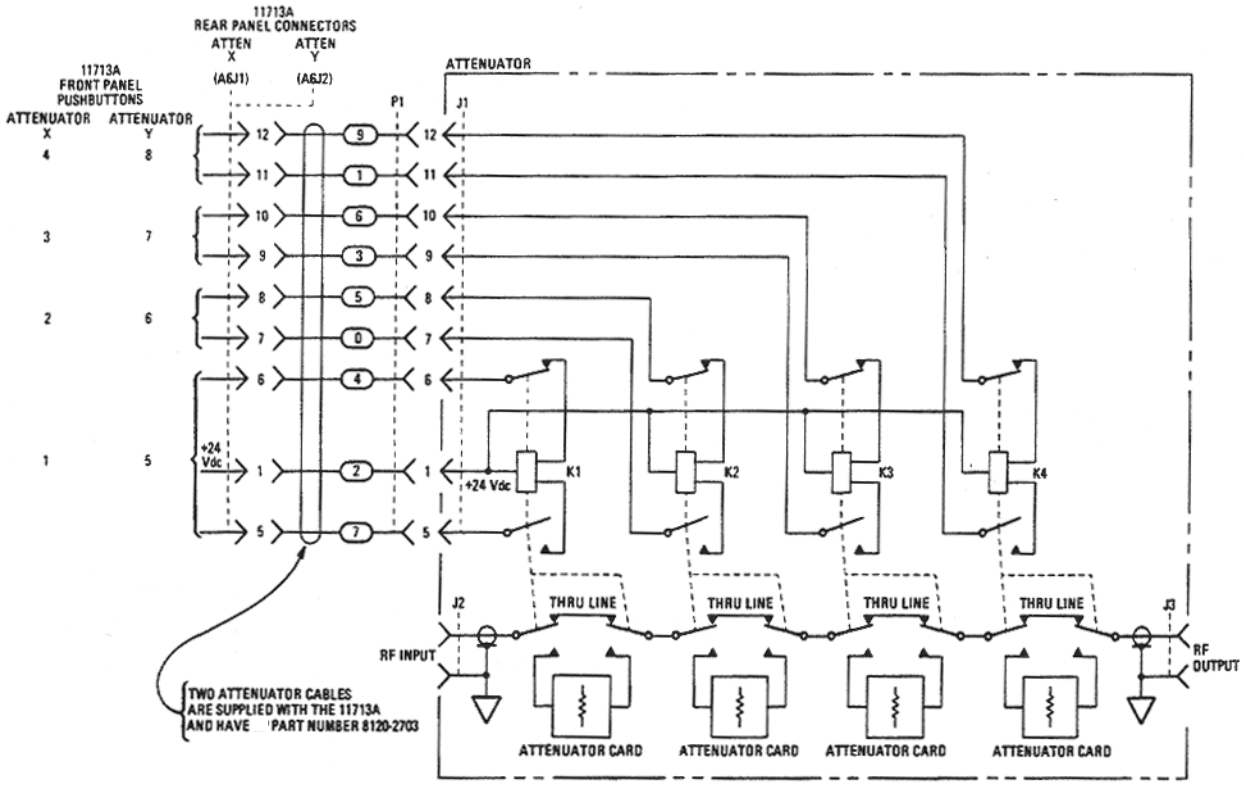
Connecting to Four-Section

❑ To use one four-section attenuator assembly, connect an attenuator cable to either the ATTEN X output (A6J1) or ATTEN Y output (A6J2). Connect both outputs to have more than four attenuator segments.

Figure 2-6 shows a typical connection for a programmable four-section attenuator and illustrates the connection/pin number for each connector: ATTEN X or ATTEN Y Using these same connections to Agilent 8762 or 8765 series coaxial switches, control can be extended to four, eight, or ten switches if S0 and S9 outputs are also used.

Figure 2-6 Typical Connections for Programmable Four-Section Attenuator



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Connecting to Relays

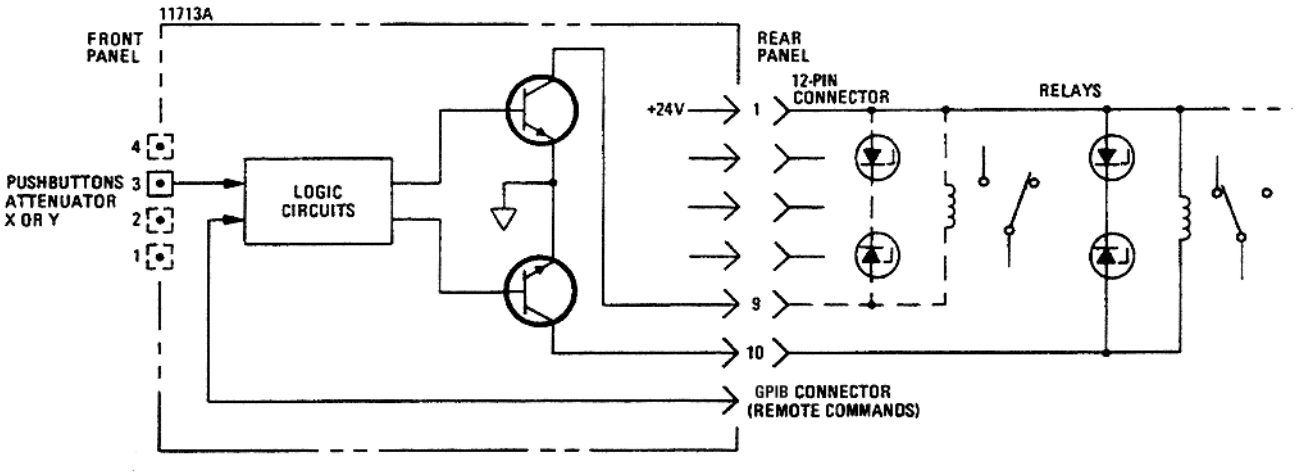
❑ To drive ten devices, connect attenuator cables at ATTEN X and Y and switch cables to S9 and S0.

A total of 10 relays may be on at one time if the total current is less than 650 mA. However, since there are dual transistor and relay drivers, where one driver is on while the other is off, a total of 20 relays may be controlled.

Figure 2-7 shows the connections for a simplified relay driving circuit. This circuit is adaptable for simple non-latching relays.

CAUTION If the total continuous load current of 650 mA is exceeded, damage may result.

Figure 2-7 Relay Driving Circuit



NOTE It is also recommended that two 28.7 V zener diodes be connected back-to-back across the relay coils to reduce voltage transients.

Verifying Performance

9. Use the procedure for checking the electrical performance of the attenuator/switch driver given in Chapter 4. If there is mechanical damage or a defect, or if the instrument does not pass the electrical performance test, notify the nearest Agilent Technologies office.

WARNING **To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portions of the outer enclosure (covers, panels, connectors).**

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3 Specifications

Overview

In this chapter you will find:

- Specifications which describe warranted performance standards
- Supplemental characteristics which are non-warranted parameters

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Specifications

Specifications describe warranted performance over the temperature range 0 to +55 °C after one hour of continuous operation, unless otherwise noted.

Table 3-1 Specifications

Drive Power Supply	
Voltage	+ 24 ± 2.0 Vdc
Current	1.3 A maximum peak for 1 second 0.65 A maximum continuous current Contact pairs 1 through 8, 9, and 0, maximum current of 0.65 A continuous through one or all contacts

Supplemental Characteristics

Supplemental characteristics are intended to provide useful information. They are typical but non-warranted performance parameters.

Table 3-2 Supplemental Characteristics

Power	100 or 120 Vac, +5%, –10% at 48 to 440 Hz 200 or 240 Vac, +5%, –10% at 48 to 66 Hz 80 VA maximum
Response Time	10 µs maximum for contact pairs 1 through 8 20 µs maximum for contact pairs 9 and 0
Driver Life	> 2,000,000 switchings at maximum current for contact pairs 9 and 0
Maximum Load Inductance	500 mH
Maximum Load Capacitance	< 0,01 µF for contact pairs 9 and 0
Net Weight	4.1 kg (9 lbs)
Dimensions	Height: 102 mm (4 inches including feet) Rack height: 89 mm (3.5 inches, half-width module) Width: 213 mm (8.4 inches) Depth: 295 mm (11.6 inches)

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4 Verification

Overview

In this chapter you will find:

- Recommended test equipment
- How to verify local operation
- How to verify GPIB interface remote operation

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Recommended Test Equipment

Recommended Test Table 4-1 lists the test equipment required for performance verification and Equipment troubleshooting. Equipment other than the recommended models can be used provided the minimum specifications are satisfied.

Table 4-1 Recommended Test Equipment

Instrument Type	Critical Specifications	Use[a]
Digital voltmeter	0 to + 30 Vdc	T
Attenuators (2 required)	Programmable, 4 sections	P, T
Switches (2 required)	+ 24 Vdc drive source	P, T
Controller GPIB	GPIB compatible	P, T

a. P = Performance; T = Troubleshooting

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Operator's Check for Local Operation

This check tests initial driver turn-on and local operation.

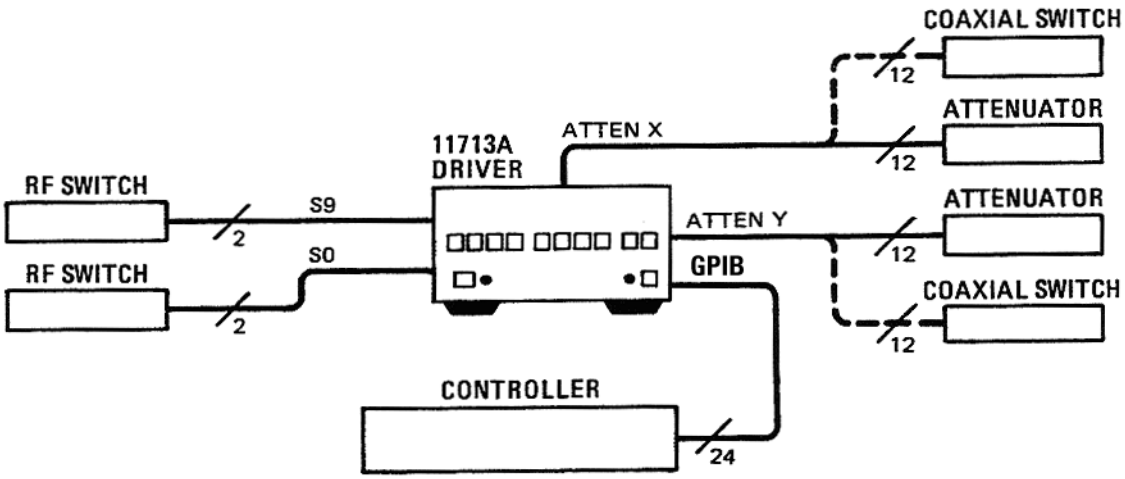
Check that the following initial conditions are met before you proceed.

- ❑ Verify that driver power transformer primary is matched to the line voltage by the Line Voltage Selection Card.
- ❑ Check the driver power fuse for correct rating. Current fuse ratings for various line voltages are given on the line power module on rear panel.
- ❑ Connect the power cable to the power receptacle.

Procedure

1. Connect the equipment that is to be used in your application as shown below.

Figure 4-1 Local Operation Test Setup



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2. Press the LINE ON/OFF switch to ON. Switch should remain in the ON position and the green switch indicator LED should illuminate. All numbered pushbutton LEDs should be on and LOCAL LED should be on.

3. Depress the 10 numbered pushbuttons on the driver front panel. Each LED should alternate between off and on as each key is pressed.

   In addition, if any equipment is connected (attenuators, relays, or switches), an audible click should be heard from the unit actuated. Pressing any numbered pushbutton should not cause any other pushbutton to change state.

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GPIB Interface Check for Remote Operation

These procedures check the driver's ability to process the GPIB messages described in the GPIB Message Reference Table 4-1. The checks can be performed together or separately.

The validity of these checks are based on the following assumptions:

- The driver operates correctly with front panel control (that is, in local mode). This can be verified with the Local Operation check.
- The controller properly executes GPIB operation.
- The GPIB interface properly executes the controller's instructions.

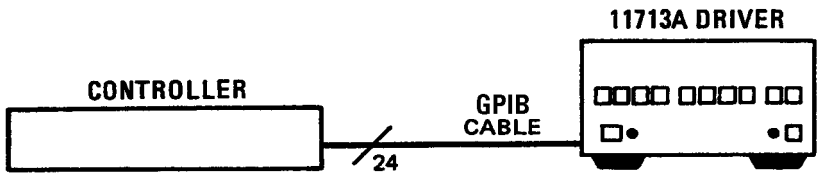
If the driver appears to fail any of the GPIB checks, the validity of the above assumptions should be confirmed before servicing the driver.

If all of these checks are successful, the driver's GPIB interface is operating correctly. These procedures do not check all of the driver's program codes that can be executed. However, if the driver works correctly from the front panel, and the GPIB interface works correctly, there is a high probability that the driver will respond to all the program codes.

Initial Setup

Connect the driver to the controller with the GPIB cable as shown in the test setup below. The cable must remain connected for all tests.

Figure 4-2 GPIB Interface Check Test Setup



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The select code of the controller's I/O is assumed to be 7. The address of the driver is assumed to be 28 (factory preset). This select code-address combination (728) is not necessary for these checks to be valid. If necessary, modify the program lines presented here with the appropriate combination for your instrument.

Remote Message

This check assumes that the driver is in the local state. If the driver is in the remote state (front panel REMOTE light ON), switch the driver off and then on again.

Description	Command
Send remote message to the driver	`REMOTE 728`

Operator's Response

Check that the driver's REMOTE light turns ON. If it does not, the driver failed to process the remote message.

Receiving the Message

This check determines if the driver receives data messages. The driver must be in the remote state. Check that all front panel LEDs are ON except local when the driver first comes on and is set to the remote state.

Description	Command
Address the driver to listen and send data messages	`OUTPUT 728; "B1234567890"` `OUTPUT 728; "A1234567890"`

Operator's Check

After the first data message is sent, check that the front-panel LEDs are OFF. After the second data message is sent, check that the LEDs are ON. If not, the driver failed to process the data message.

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Local Lockout and Clear Lockout/ Set Local Messages

This check requires the bus to be in the remote state. Check that the driver's REMOTE light is ON.

Description	Command
Local Lockout: Send Local Lockout message.	LOCAL LOCKOUT 7

Operator's Response

Press the LOCAL key on the driver front panel. The REMOTE LED should remain ON. If not, the driver failed to process the Local Lockout message.

Description	Command
Clear Lockout/Set Local: Send Clear Lockout/Set Local message to clear Local Lockout messages and set all devices to Local	LOCAL 7

Operator's Response

Check that the LOCAL light is ON and REMOTE light is OFF. Press numbered pushbutton switches and check that switches change status (LEDs on and off). If not, the driver failed to process the Clear Lockout/Set Local message.

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5 Local Operation

Overview

In this chapter you will find:

- Function and description of front panel controls, connectors, and indicators
- Function and description of rear panel controls, connectors, and indicators

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Local Control

Local control of the Agilent 11713A switch driver is accomplished manually from front panel pushbuttons.

Figure 5-1 and Figure 5-2 detail front and rear panel controls, connectors, and indicators.

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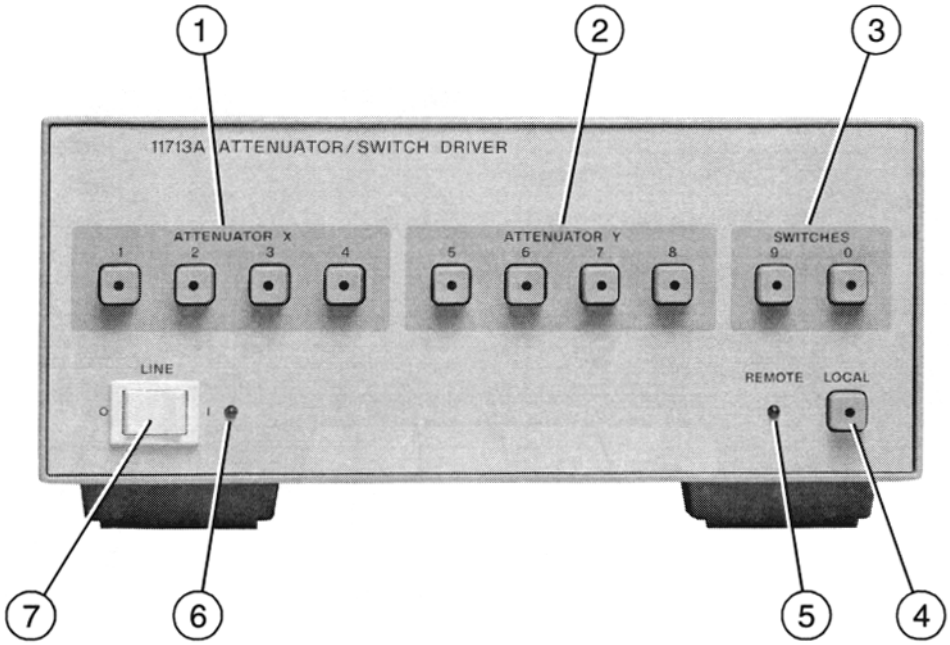
Figure 5-l Front Panel Features



[1] ATTENUATOR X

In the local mode, pushbutton switches 1, 2, 3, and 4 activate solid state switches (current sinks) to change the attenuation setting of an attenuator connected to the ATTEN X connector on the rear panel.

[2] ATTENUATOR Y
In the local mode, pushbutton switches 5, 6, 7, and 8 activate solid state switches (current sinks) to change the attenuation setting of an attenuator connected to the ATTEN Y connector on the rear panel.

[3] S9 A,B
In the local mode, Pushbutton switches 9 and 0 change the position of a coaxial switch connected to rear panel banana jacks S9 A, B and S0 A, B respective y.

[4] LOCAL

Pushbutton switch that resets to the local mode when not in local lockout. LED turns on in LOCAL mode.

[5] REMOTE LED
When on, the remote LED indicates that the driver is in remote control.

[6] LINE ON LED When on, this LED indicates that power is applied to the attenuator/switch drives.

[7] LINE OFF/ON
The line off/on button controls primary power

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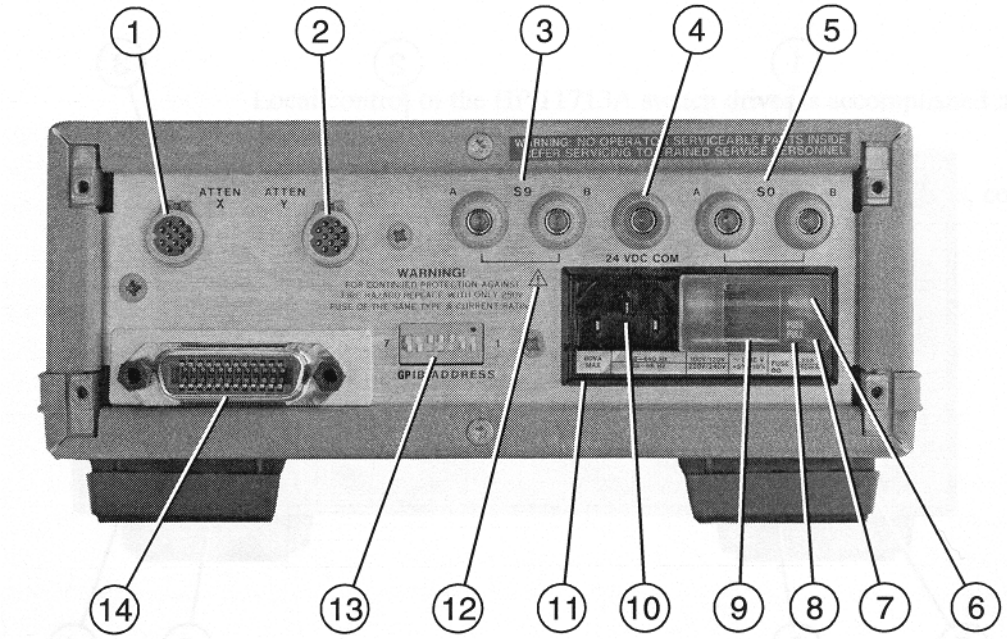
Figure 5-2 Rear Panel Features



[1] ATTEN X

Connector to accept cable plug going to programmable attenuator X

[2] ATTEN Y

Connector to accept cable plug going to programmable attenuator Y

[3] S9 A,B

Banana jack connectors for hook up to the coaxial switches

[4] 24 Vdc

Banana jack connector provides the common connection for the +24 Vdc used to drive the coaxial switches.

[5] S0 A,B

Banana jack connectors for hook up to the coaxial switches

[6] Window

Safety interlock; fuse cannot be removed while power cable is connected to power receptacle

[7] Fuse Pull Handle

Mechanical interlock; fuse must be removed before extraction of Line Voltage Selection Card

[8] Fuse

1.25 A at 110/120 Vac; 750 mA at 220/240 Vac

[9] Line Voltage Selection Card

Matches transformer primary to line voltage

[10] Receptacle

Matches transformer primary to line voltage via power cable

[11] Line Power Module Assembly

[12]

This symbol is used to point out a necessary reference for the user.

[13] GPIB Address

Switches to set the address of the driver (decimal 28 is factory preset)

[14] GPIB Connector

The interface connector from a source device to a listening device for the remote mode of operation

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6 Remote Operation

Overview

In this chapter you will learn about:

- Remote programming capability of the attenuator/switch driver
- Function and use of GPIB commands in remote mode
- Programming information to set up desired level of attenuation

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The driver can be operated remotely through the General Purpose Interface Bus (GPIB).

GPIB Compatibility

Remote-only functions and all front panel functions (except the LINE switch) are programmable through the GPIB. The operator's interface check in Chapter 4, "Verification" provides a test of the GPIB to verify that the driver can function with each of the applicable bus messages. Table 6-1 summarizes the driver's GPIB capabilities in terms of the twelve bus messages.

Remote Mode

The driver accepts commands from the bus in the remote mode. In remote, its front panel controls are disabled (except for the LINE switch and the LOCAL pushbutton). The LOCAL pushbutton can be disabled by a local lockout command. The driver can be addressed to listen and when addressed to listen, the driver will respond to the following messages: Data, Remote, Local Lockout, and Clear Lockout/Set Local.

Local-to-Remote Changes

The driver switches to remote operation upon receipt of the Remote message. The Remote message has two parts:

- Remote enable bus control line (REN) set true
- Device listen address (MLA) received once (while REN is true)

The driver's outputs and all control settings remain unchanged with the Local-to-Remote transition. The REMOTE LED is ON when the driver is in the remote state.

Local Mode

In local, the driver's front-panel controls are fully operational and the instrument will respond to the Remote message. Whether addressed or not, it will also respond to the Local Lockout and Clear Lockout/Set Local messages.

Remote-to-Local Changes

The driver returns to local control upon receipt of the Clear Lockout/Set Local message ($\overline{\text{REN}}$). If the driver is not in Local Lockout, it switches to local from remote when the front panel LOCAL key is pressed. With the remote-to-local transition, the driver's outputs remain unchanged.

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Local Lockout

The local lockout condition disables the front panel LOCAL key so that pressing the LOCAL key will not return the driver to local mode. When local lockout is in effect, the driver is returned to local under program control.

(sending Clear Lockout/Set Local) or by turning the driver LINE switch OFF and ON. However, returning to local by switching to OFF and then ON, will defeat the purpose of local lockout and the system controller will lose control.

Addressing

The driver's listen address is set by the slide switches on the rear panel. Refer to "GPIB Addressing".

Data Messages

The state of the driver is controlled by data message on the GPIB. Data messages include the driver's GPIB program codes. The GPIB program codes contain information for programming the front panel functions (except for the LINE switch). The driver receives data messages when addressed to listen.

Receiving the Data Message

The driver responds to data messages when in remote and addressed to listen.

Data Message Input Format

The programming data string for the driver consists of a string of ASCII coded characters composed of one or both of the following fields:

[Adm] [Bdn]

where: A or a = general ON command; B or b = general OFF command

dm = any digits 0 through 9 (excluding dn)

dn = any digits 0 through 9 (excluding dm)

The driver responds to an alphanumeric data string such as "A12B34" when the driver is in the remote state and addressed to listen. (The alpha characters in the data string can be either upper or lower case).

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The data string is further defined as follows:

Ax Bx Ay By A/B 9 A/B 0

where: Ax Bx = data string for ATTEN X

(x can be none, one or more of the digits 1, 2, 3, or 4)

Ay By = data string for ATTEN Y

(x can be none, one or more of the digits 5, 6, 7, or 8)

Note that if Ax (Ay) uses a digit, then that digit may not be used in Bx (By).

A/B 9 = GPIB command for switch S9

A/B 0 = GPIB command for switch S0

The data string contains the operation selected by the user (desired contact closure, value of attenuation, etc.). The coded command from the controller is converted by the driver into control voltages. The output control voltages drive the device and illuminate front panel lights that indicate the operation selected.

- ❏ Table 6-2 shows the relationship between each programming code and the effect it has on the output at each connector/pin.
- ❏ Table 6-3 shows the programming strings required to set up various three and four-section attenuators to the desired levels of attenuation.

Program Execution Time

The response time for the driver is defined as the time between data valid (DAV) changing from a high to a low and the output signal at the rear panel connector changing state. The switching speed of the Agilent Technologies programmable attenuators is 20 ms including 10 ms for the driver (ATTEN outputs). The switching speed for the RF switches is 20 to 50 ms plus 20 ms for the driver (S9 and S0 outputs).

Sending the Data Message

The driver does not have the capability of sending a data message.

Receiving the Trigger Message

The driver does not respond to the Trigger message.

Receiving the Clear Message

The remote message causes the driver to switch to the remote mode. The remote message has two parts: the remote enable (REN) and address-to-listen. The driver's outputs do not change with the local-to-remote transition. The REMOTE LED turns on when the driver is in remote mode.

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Receiving the Local Message

The driver does not respond to the local message. When the driver is in Local Message remote mode, it can be returned to local mode with a Clear Lockout/Set Local message.

The front panel LOCAL key can also return the driver to local mode. However, pressing the LOCAL key might interrupt a data message to the driver. This would leave the driver in a state unknown to the controller. This situation would be undesirable and is avoided by setting the Local Lockout condition which disables the LOCAL key.

Receiving the Local Lockout Message

The LOCAL pushbutton switch is disabled with Local Lockout in effect. The driver is returned to local through program control by the controller.

NOTE The driver may also be returned to local by turning the driver LINE switch off and then on, but this defeats the purpose of the Local Lockout and the system controller loses control.

Receiving the Clear Lockout/Set Local Message

The system controller sends a Clear Lockout/Set Local message to clear the Local Lockout condition and return all devices to local. No instrument settings are changed when going from local lockout (remote control) to local control.

Receiving the Pass Control Message

The driver does not respond to the Pass Control message because it cannot act as a controller

Sending the Require Service Message

The driver cannot send a Require Service message.

Sending the Status Byte Message

The driver does not respond to a serial poll and as a result does not send the Status Bit message.

Sending the Status Bit Message

Table 6-1 summarizes the driver's GPIB capabilities in terms of the twelve bus messages.

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Table 6-1 summarizes the driver's GPIB capabilities in terms of the twelve bus messages.

Table 6-1 GPIB Message Reference Table

GPIB Message	Applicable	Response	Related Commands and Controls[a]	Interface Functions
Data	yes	All front panel functions, except LINE ON/OFF switch, are programmable. The front panel REMOTE indicator turns on when addressed.		TO, L2, AH1, SH0
Data	No	The driver does not respond to the trigger message	GET	DT0
Trigger	No	The driver does not respond to the clear message.	DCL, SDC	DC0
Clear	No	The driver does not respond to the clear message	REN	RL1[b]
Remote	Yes	The driver remote mode is enabled when the REN bus line is true. However, R remains in local (i.e, the front panel is active) until it is addressed to listen the first time. The output signal is unchanged. The front panel REMOTE indicator turns on when in remote mode.	GTL	RL1[b]
Local	No	The driver does not respond to the Local message. Refer to Clear Lockout/set Local.	LLO	RL1[b]
Local Lockout	Yes	LOCAL key is disabled. Only the controller can return to the driver to local.	$\overline{\text{REN}}$	RL1[b]
Clear Lockout/ Set Local	Yes	Driver goes to local and local lockout is cleared when REN goes false.		RL1[b]
Pass Control/Take Control	No	The driver has no controller capability	SRQ	SR0
Require Service	No	The driver does not respond to a serial poll.	SPE, SPD	T0
Status Byte	No	The driver does not respond to a parallel poll.		PP0
Abort	No	The driver stops listening	IFC	T0,L2

a. Commands, control lines and Interface functions are defined in IEEE Std 488 and ANSI Sid MC1.1. Knowledge of these might not be necessary if your controller's manual describes programming in terms of the twelve GPIB messages shown in the left column.

b. The driver does not have complete RU capability since it can not process the Go-To-Local (GTL) message.

Complete GPIB capability as defined in IEEE Std 488 and ANSI Std MC1.1 is:

SH0, AH1, T0, TE0, L2, LE0, DC0, DT0, RL1, C0, SR0, PP0.

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Table 6-2 gives the relationship between each programming code and the effect it has on the output at each connector/pin.

Table 6-2 GPIB Control Statement Results

Front Panel Digits	Connector	Connector Pin Numbers	Command Result	
			A	B
1	ATTEN X	5	H	L
		6	L	H
2		7	H	L
		8	L	H
3		9	H	L
		10	L	H
4		11	H	L
		12	L	H
5	ATTEN Y	5	H	L
		6	L	H
6		7	H	L
		8	L	H
7		9	H	L
		10	L	H
8		11	H	L
		12	L	H
9	S9	A	⏚	+24 VB
		B	+24 V	⏚
0	S0	A	⏚	+24 V
		B	+24 V	⏚

H= Open (High)

L =Closed (Low)

⏚ =Connected to ground

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Table 6-3 shows the programming strings required to set up various three and four-section attenuators to the desired level of attenuation.

Table 6-3 Attenuation Levels and Corresponding Data Strings

0 to 11 dB or 0 to 110 dB Attenuation 4-Section Attenuator									
ATTENUATOR X (Pushbuttons)		**1**	**2**	**3**	**4**	**ATTENUATOR Y (Pushbuttons)**		**5**	**6**	**7**	**8**
Attenuator Section (dB)		**1**	**2**	**4**	**4**	**Attenuator Section (dB)**		**10**	**20**	**40**	**40**
Attenuation (in dB)						**Attenuation (in dB)**					
X	Y	ATTEN X			ATTEN Y	X	Y	ATTEN X			ATTEN Y
0	0	B1234			B5678	6	60	A24B13			A68B57
1	10	A1B234			A5B678	7	70	A124B3			A568B7
2	20	A2134			A6B578	8	80	A34B12			A78B56
3	30	A12B34			A56B78	9	90	A134B2			A578B6
4	40	A4B123			A8567	10	100	A234B1			A678B5
5	50	A14B23			A58B67	11	110	A1234			A5678
0 to 70 dB Attenuation 3-Section Attenuator											
ATTENUATOR X (Pushbuttons)		**1**	**2**	**3**	**4**	**ATTENUATOR Y (Pushbuttons)**		**5**	**6**	**7**	**8**
Attenuator Section (dB)		**10**	**20**	**40**	**Not Used**	**Attenuator Section (dB)**		**10**	**20**	**40**	**Not Used**
Attenuation (in dB)						**Attenuation (in dB)**		**GPIB Program Codes**			
X	Y	ATTEN X			ATTEN Y	X or Y		ATTEN X			ATTEN Y
0	0	B123			B567	40		A3B12			A7B56
10	10	A1B23			A5B67	50		A13B2			A67B5
20	20	A2134			A56B7	60		A23B1			A67B5
30	30	A12B3			A56B7	70		A123			A567
0 to 70 dB Attenuation 4-Section Attenuator											
ATTENUATOR X (Pushbuttons)		**1**	**2**	**3**	**4**	**ATTENUATOR X (Pushbuttons)**		**5**	**6**	**7**	**8**
Attenuator Section (dB)		**10**	**20**	**20**	**20**	**Attenuator Section (dB)**		**10**	**20**	**20**	**20**
Attenuation (in dB)						**Attenuation (in dB)**		**GPIB Program Codes**			
X or Y		ATTEN X			ATTEN Y	X or Y		ATTEN X			ATTEN Y
0		B1234			B5678	40		A24B13			A68B57
10		A1B234			A5B76	50		A124B3			A568B7
20		A4B123			A8B568	60		A234B1			A678B5
30		A14B23			A58B67	70		A1234			A5786

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7 Replacing Major Assemblies

Overview

In this chapter you will find:

- Replaceable parts and connecting accessories
- Procedures for the removal and replacement of major assemblies in the 11713A attenuator/switch driver
  - ❍ Module cover
  - ❍ Front panel
  - ❍ Rear panel
  - ❍ A1 interconnect and power supply assembly
  - ❍ A2 driver assembly
  - ❍ A3 latch assembly
  - ❍ A4 remote local logic assembly
  - ❍ A5 GPIB handshake and data input assembly
  - ❍ A6 interface assembly
  - ❍ A7 switch board assembly
  - ❍ A8 power module/line filter assembly

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Replaceable Parts

Table 7-1 lists the accessories that are supplied with the 11713A attenuator/switch driver. Other available accessories are listed in Table 1-3. For ordering information, refer to "Service and Support" on page v in the front matter of this manual.

Table 7-1 Accessories Supplied

Item	AgilentPart Number
Dual Viking connectors, 12-pin conductor, 60 inches long (2)	8120-2703
Line power cable	Part number will vary[a]
11713A Operating and Service Manual1	1713-90023

a. The power cable is selected at the factory according to the voltage available in the country of destination.

Table 7-2 Line Fuse Part Numbers

Line Voltage	Line Fuse	Agilent Part Number
100 V/120 V	Fast blow 1.25 A	2110-0094
220 V/240 V	Fast blow 750 mA	2110-0063

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Major assemblies and cables of the 11713A attenuator/switch driver are listed below. For ordering information, refer to "Service and Support" on page v in the front matter of this manual

Table 7-3 Major Assemblies

Assembly Reference Designator	Agilent Part Number
A1 interconnect and power supply assembly	11713-60012
A2 driver assembly	11713-60016
A3 latch assembly	11713-60003
A4 remote local logic assembly	11713-60004
A5 GPIB handshake data input assembly	11713-60014
A6 interface assembly	11713-60010
A7 switch board assembly	11713-60007
A8 power module/line filter assembly	0960-0443

Table 7-4 Major Cables

Cable Reference Designator	Agilent Part Number
W1 12-conductor	8120-2703
W2 12-conductor	8120-2703
W3 34-conductor	8120-2811
W4 34-conductor	8120-2811
W5 18 awg 3-conductor	8120-1378
W6 line ON/OFF (includes S1)	11713-60013

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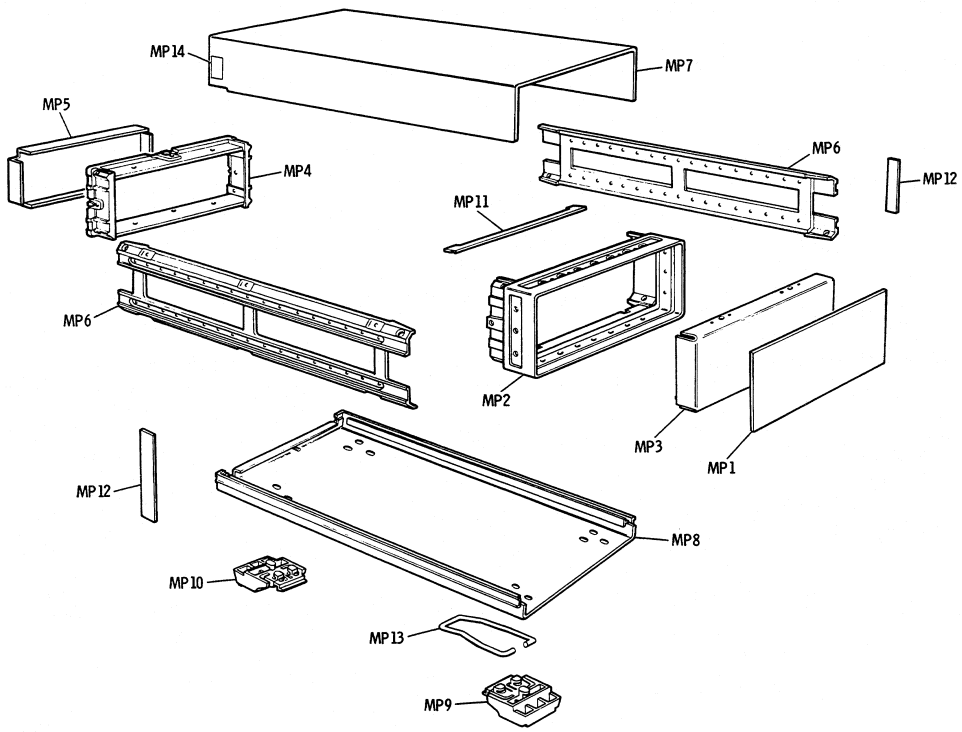
Table 7-5 Cabinet Parts

Reference Designation	Agilent Part Number	Qty	Description
MP1	11713-00024	1	Front panel
MP2	5021-8413	1	Front panel
MP3	11713-00005	1	Sub panel
MP4	5021-8413	1	Rear frame
MP5	11713-00012	1	Rear panel
MP6	5021-5829	2	Side strut
MP7	5021-9253	1	Top cover, perforated
MP8	5062-3871	1	Bottom cover, perforated
MP9	5040-8801	2	Foot (standard)
MP10	5040-8803	2	Foot, non-skid
MP12	5001-0538	2	Side trim
MP13	1460-1345	1	Tilt stand
MP14	7120-4294	1	Label
MP15	7120-1254	1	Nameplate



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Module Cover Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

NOTE Top and bottom covers are removed and replaced similarly.

To Remove Module Covers

1. Unscrew the one single screw in the middle of the cover flange that holds the cover to the rear panel.
2. Slide the cover toward the rear of the module.

To Replace Module Covers

1. Slide the cover toward the front of the module.
2. Tap on the cover to ensure that all sides fit snugly.
3. Tighten the holding screw at the rear flange.

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Front Panel Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the Front Panel

1. Remove the top and bottom covers. Refer to "Module Cover Removal/Replacement".
2. Remove the four corner screws that hold the front panel to the frame.
3. Disconnect the ribbon cable from the A1 interface/power supply assembly to the front panel.
4. Unscrew the five screws that hold the front panel board onto the front panel frame.

To Replace the Front Panel

1. Install the front panel board onto the front panel frame using five screws.
2. Connect the ribbon cable from the A1 interface/power supply assembly to the front panel
3. Use the four corner screws to secure the front panel board to the frame.
4. Replace the covers.

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Rear Panel Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the Rear Panel

1. Remove the top and bottom covers. Refer to "Module Cover Removal/Replacement".
2. Remove the two screws at the GPIB connector.
3. Remove the four comer screws that secure the rear panel to the module.
4. Disconnect the ribbon cable from the A1 interconnect/power supply assembly to the rear panel.
5. Separate the rear panel from the module.

To Replace the Rear Panel

1. Position the rear panel onto the rear-panel frame.
2. Connect the ribbon cable from the A1 interconnect/power supply assembly to the rear panel.
3. Secure the rear panel to the module with the four comer screws.
4. Replace the two screws at the GPIB connector.
5. Replace the top and bottom covers.

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A1 Interconnect and Power Supply Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the A1 Interconnect/Power Supply Assembly

1. Remove the top and bottom covers. Refer to "Module Cover Removal/Replacement".
2. Remove the front and the rear panel from the module.
3. Using their individual rings, pull the four boards, A2 driver, A3 latch, A4 remote local logic, and A5 GPIB assemblies from their sockets one at a time.
4. Disconnect both ribbon cables from the front and rear panels to the A1 interconnect/power supply assembly.
5. Disconnect the power transformer connector.
6. Remove the power transformer by removing the four mounting screws, nuts, and washers.
7. Unscrew the ten small screws and three large screws to separate the A1 interconnect/power supply assembly from its frame

To Replace the A1 Interconnect/Power Supply Assembly

1. Replace the 3 large screws and the ten small screws that secure the assembly to the frame.
2. Replace the four long mounting screws with the corresponding nuts and washers to install the power transformer onto the board.
3. Connect the power transformer connector onto its matching connector.
4. Connect both ribbon cables from the A1 interconnect/power supply assembly to the front and rear panels.
5. Assemble the front and rear panel to the frame using four screws for each panel.
6. Install all four boards, A2 driver, A3 latch, A4 remote local logic, and A5 GPIB assemblies into their sockets.
7. Replace the module covers.

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A2 Driver Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8

To Remove the A2 Driver Assembly

1. Remove the top cover.
2. With a strong upward motion, lift the red ring at the top edge of the A2 driver and remove the assembly.

To Replace the A2 Driver Assembly

1. Gently insert the board into the socket marked A2 with a vertical motion. Use balanced pressure from your thumbs to push the board into the socket.
2. Replace the top cover.

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A3 Latch Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the A3 Latch Assembly

1. Remove the top cover.
2. With a strong upward motion, lift the orange ring at the top edge of the A3 latch assembly.

To Replace the A3 Latch Assembly

1. Gently insert the board into the socket marked A3 latch assembly with a vertical motion. Apply balanced pressure with your thumbs to push the board into the socket.
2. Replace the top cover.

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A4 Remote Local Logic Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the A4 Remote Local Logic Assembly

1. Remove the top cover.
2. With a strong upward motion, lift the yellow ring at the top edge of the A4 remote local logic assembly

To Replace the A4 Remote Local Logic Assembly

1. Gently insert the board with a vertical motion into the socket marked A4 remote local logic assembly. Apply balanced pressure with your thumbs to push the board into the socket
2. Replace the top cover.

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A5 GPIB Handshake Data Input Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the A5 GPIB Assembly

1. Remove the top cover
2. With a strong upward motion, lift the green ring at the top edge of the A5 GPIB handshake data input assembly.

To Replace the A5 GPIB Assembly

1. Gently insert the board with a vertical motion into the socket marked A5 GPIB handshake data input assembly. Apply balanced pressure with your thumbs to push the board into the socket.
2. Replace the top cover

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A6 Interface Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the A6 Interface Assembly

1. Remove both covers. Unscrew one screw on each cover and then slide the cover toward the rear.
2. Disconnect the ribbon cable from the A1 interconnect assembly to the rear panel.
3. Remove the rear panel from the main frame by removing the four corner screws.
4. Remove the three screws that secure the A6 interface assembly.

To Replace the A6 Interface Assembly

1. Use the three screws to install the A6 interface assembly to the rear panel.
2. Assemble the rear panel to the main frame using the four corner screws.
3. Connect the ribbon cable from the rear panel to the A1 interconnect assembly.
4. Replace the module covers.

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A7 Switch Board Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the A7 Switch Board Assembly

1. Remove both covers. Unscrew one screw on each cover and then slide the cover toward the rear.
2. Disconnect the ribbon cable from the A1 interconnect assembly to the rear panel.
3. Remove the front panel from the main frame by removing the four corner screws.
4. Remove the five screws that secure the A7 switch assembly to the front panel and remove the board

To Replace the A7 Switch Board Assembly

1. Replace the board using five screws to install it onto the front panel.
2. Assemble the front panel to the main frame using the four comer screws.
3. Connect the ribbon cable from the rear panel to the A1 interconnect assembly.
4. Replace the module cover.

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A8 Power Supply/Line Filter Assembly Removal/Replacement

CAUTION This module contains components that can be damaged or destroyed by electrostatic discharge. It should be serviced at a static-safe workstation. Refer to "Preparing a Static-Safe Work Station" in Chapter 8.

To Remove the A8 Power Supply/Line Filter Assembly

1. Locate the line filter unit behind the power connector where power cable plugs in.
2. Before proceeding, make sure you *identify* and *record* the color of the transformer wire and the corresponding pin number.
3. Desolder the transformer wires and unplug the two wires from the power switch cable.
4. Desolder the ground wire on the metallic cover of the unit.
5. Remove the rear panel from the main frame by removing the four comer screws.
6. Bend the two sides of the assembly to release the lock while gently removing the line filter assembly.

To Replace the A8 Power Supply/Line Filter Assembly

1. Push the new assembly into the opening.
2. Solder all wires. Take care to connect the correct color of transformer wire to the corresponding pin number.
3. Plug in the two wires from the power switch cable.
4. Solder the ground wire to the previous location on the metallic cover of the unit.
5. Reassemble the rear panel to the module.
6. Replace the module covers.

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8 Servicing the Attenuator/Switch Driver

Overview

In this chapter you will find:

- How to prepare a static-safe work station
- How to replace the rear-panel fuse
- Troubleshooting hints for diagnosing common problems
- Assembly level troubleshooting

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Preparing a Static-Safe Workstation

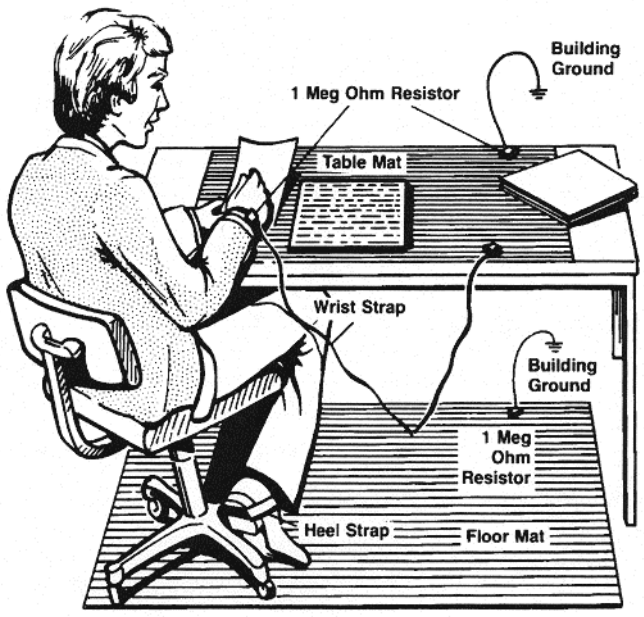
Electrostatic discharge (ESD) can damage or destroy electronic components. All work performed on assemblies consisting of electronic components should be done at a static-safe workstation.

An example of a static-safe work station is shown below using two types of ESD protection:

- ❍ conductive table mat and wrist strap combination, and
- ❍ conductive floor mat and heel strap combination

These methods may be used together or separately. A list of static-safe accessories and their part numbers is given on the following page.

Figure 8-1 Static-Safe Work Station



Reducing ESD Damage

To help reduce the amount of ESD damage that occurs during installation, testing, or servicing instruments use the following guidelines:

- Be sure that all instruments are properly earth-grounded to prevent buildup of static charge.
- Personnel should be grounded with a resistor-isolated wrist strap before touching the center pin of any connector and before removing any assembly from the instrument.

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- Before connecting any coaxial cable to an instrument connector for the first time each day, momentarily ground the center and outer conductor of the cable.
- Handle all PC board assemblies and electronic components only at static-safe work stations.
- Store or transport PC board assemblies and electronic components only in static-shielding containers.
- PC board assembly edge-connector contacts may be cleaned by using a lintfree cloth with a solution of 80% electronics-grade isopropyl alcohol and 20% deionized water. This should be performed at a static-safe work station.

Table 8-1 Static-Safe ESD Accessories

Agilent Part Number	Description
9300-0797	Set includes:
	3M static control mat 0.6 m x 1.2 m (2 ft x 4 ft) and 4.6 m (115 ft) ground wire (The wrist-strap and wrist-strap cord are not included. They must be ordered separately)
9300-0865	Ground wire, 4.6 m (15 ft)
9300-0980	Wrist-strap cord 1.5 m (5 ft)
9300-1367	Wrist-strap, color black, stainless steel, without cord, has four adjustable links and a 7-mm post-type connection.
9300-1308	ESD heel-strap (reusable 6 to 12 months)

Order the above by calling any Agilent Technologies Sales and Service Office.

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Maintenance and Adjustments

Fuse Removal/Replacement

User maintenance is limited to replacement of the rear panel fuse. The main ac line fuse is located on the rear panel in the line power module.

Use the following procedure to remove the fuse. Refer to Figure 3-2.

1. Remove the line power cable from its jack.
2. Open the cover door of the line power module.
3. Push the fuse-pull lever to the left and remove the fuse.
4. Replace the fuse with one of the correct rating and type for your selected input ac line voltage. Fuse ratings for line voltages are indicated below the power module.

WARNING Be sure to select the correct fuse rating for the selected line voltage. Do not use repaired fuses or short circuited fuse-holders. To do so could cause a shock or fire hazard.

Adjustments

The 11713A attenuator/switch driver has no internal electrical or mechanical adjustments.

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Troubleshooting

Isolating a Malfunction

Use the following procedure to help you isolate a malfunction.

- ❏ Recommended test equipment for troubleshooting is listed in Table 4-1.
- ❏ Figure 8-2 and Figure 8-3 identify the assemblies and test points specified in the steps below.

Procedure

1. Remove the switch driver top cover. Refer to "Module Cover Removal/Replacement".
2. Turn on the driver and verify that the proper power up status is reached. The driver should come up in local with all pushbutton LEDs on, which corresponds to the maximum attenuation settings.
3. Measure the voltages at A1TP1 and A1TP2

   TP1 = + 5.0 ± 0.5 Vdc

   TP2 = + 24.0 ± 1.0 Vdc
4. Verify that the + 24.0 ± 1.0 Vdc is present at the rear panel red banana jack.
5. If an attenuator or switch buzzes when actuated by the front panel pushbutton, the output transistor may be shorted, or one of the protection diodes may be shorted.
6. If one of the pushbutton LEDs does not light, determine if the pushbutton is operational by checking to see if the circuitry drives an attenuator or switch properly. If the switching click of the relay in the attenuator or switch can be heard, only the LED may be defective.
7. Check the driver in full local operation before testing in remote operation.

   If a pushbutton does not actuate an attenuator section or change the position of a coaxial switch, do the following:

   a. Check the output pulses of the A7 switch board assembly either at the A7 outputs or on the multiplexer inputs of the A4 remote local logic assembly.

   b. If the pulses are present when the corresponding front panel button is pushed, check the output of the A4 multiplexers. Verify that the multiplexers are in local mode of operation.

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c. Verify that the pulse reaches the clock input of A3 latch assembly driver assembly storage register flip-flops. Verify that the Q and NQ outputs change state as the corresponding pushbutton is exercised.

d. Measure input and output levels of inverting drivers on the A2 driver assembly.

e. If all logic levels up to the Darlington transistors operate, check for shorted or open Darlington transistors. For proper operation the voltage across the series base resistor to the Darlington transistors should be greater than or equal to 0.5 Vdc when the transistor is on.

8. To check the driver in remote operation with no external loads connected, use an appropriate controller program to execute the following commands.

Command	Desired Outcome
`REMOTE 728`	The REMOTE light turns ON.
`OUTPUT 728;"Al2345678"`	All attenuator lights go ON except the local light.
`OUTPUT 728;"Bl2345678"`	All attenuator lights go OFF except the remote light.

NOTE The default address 728 is set at the factory. If you are using a different address number, replace 728 in the commands above with the appropriate address of your instrument. Refer to "GPIB Addressing".

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Parts Identification

Figure 8-2 and Figure 8-3 identify the location of the following assemblies and parts referred to in troubleshooting procedures.

Assembly Reference Designator	Agilent Part Number
A1 interconnect and power supply assembly	11713-60012
A1C1 capacitor 1300 µF 50 V	0180-2181
A1C1 capacitor 7200 µF 15 V	0180-2221
A1U1 voltage regulator	1826-0181
A1U2 voltage regulator	1826-0559
A2 driver assembly	11713-60016
A3 latch assembly	11713-60003
A4 remote local logic assembly	11713-60004
A5 GPIB handshake data input assembly	11713-60014
A6 interface assembly	11713-60010
A7 switch board assembly	11713-60007
A8 power module/line filter assembly	0960-0443
A8C1 capacitor.1µ F 250 Vac(RMS)	0160-4065
F1 fuse 1.25 A/250 V	2110-0094
MP39 heatsink	11713-00022
T1 transformer	9100-4080
W4 34-conductor	8120-2811
W6line ON/OFF (includes S1)	11713-60013

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Figure 8-2 11713A Attenuator/Switch Driver Top Cover Removed

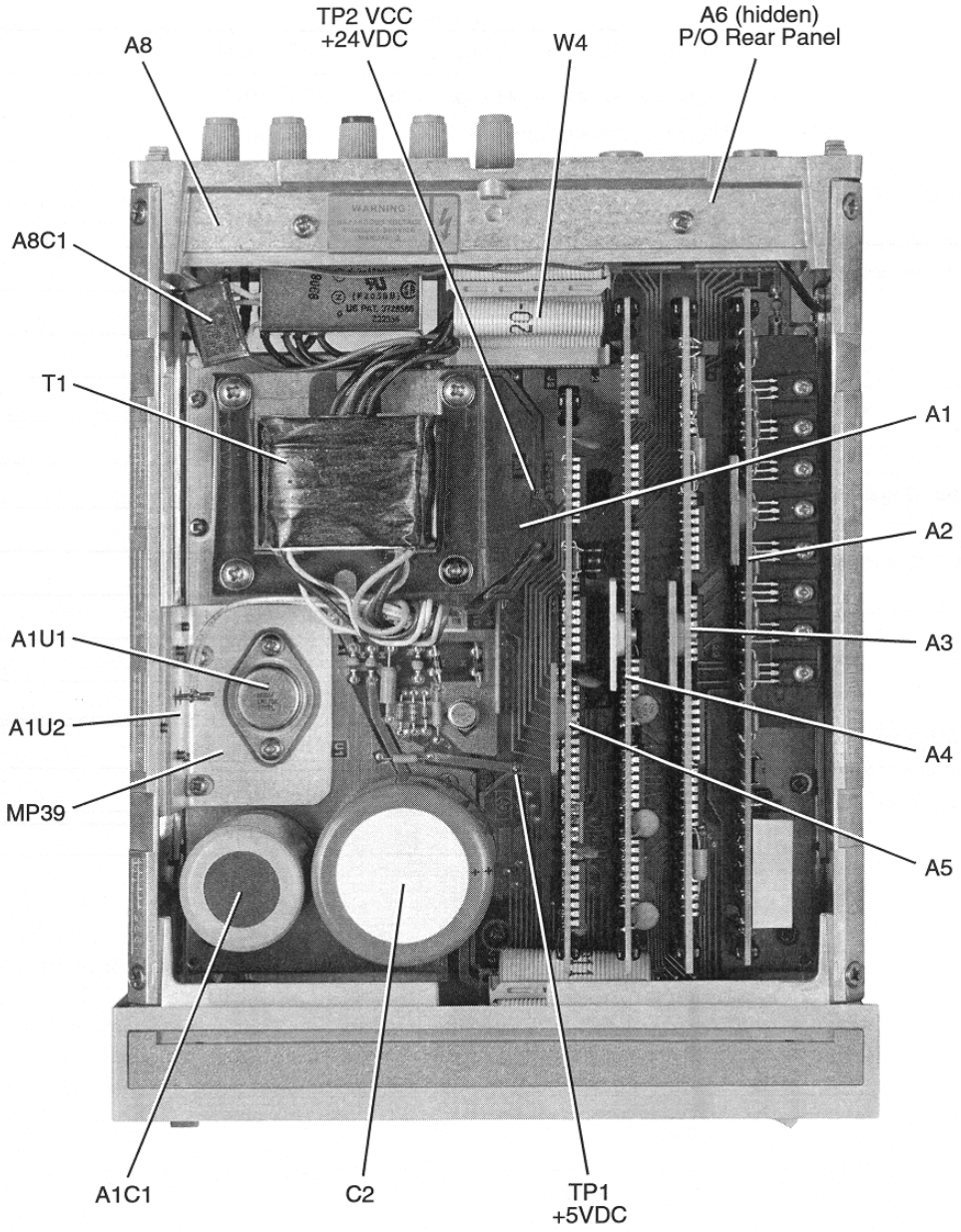

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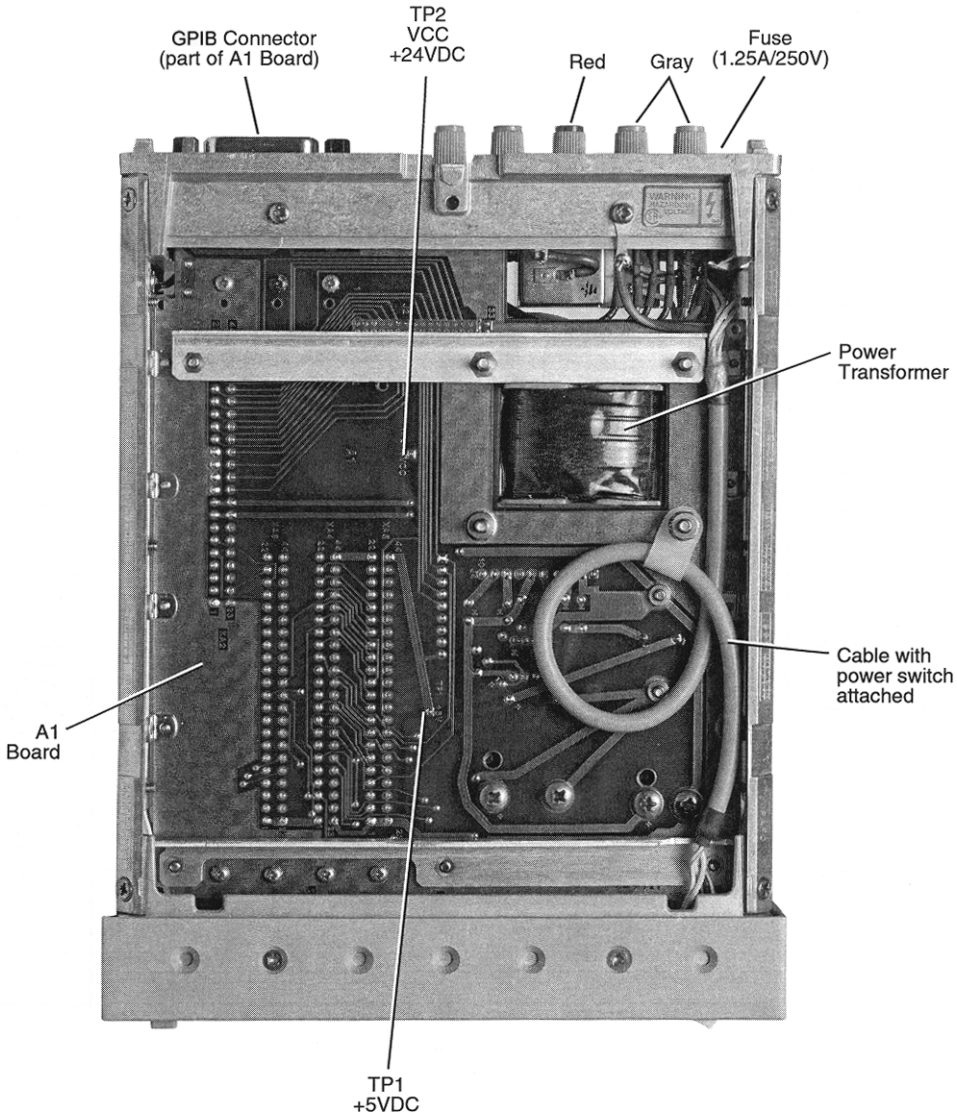
Figure 8-3 11713A Attenuator Switch Driver Bottom Cover Removed



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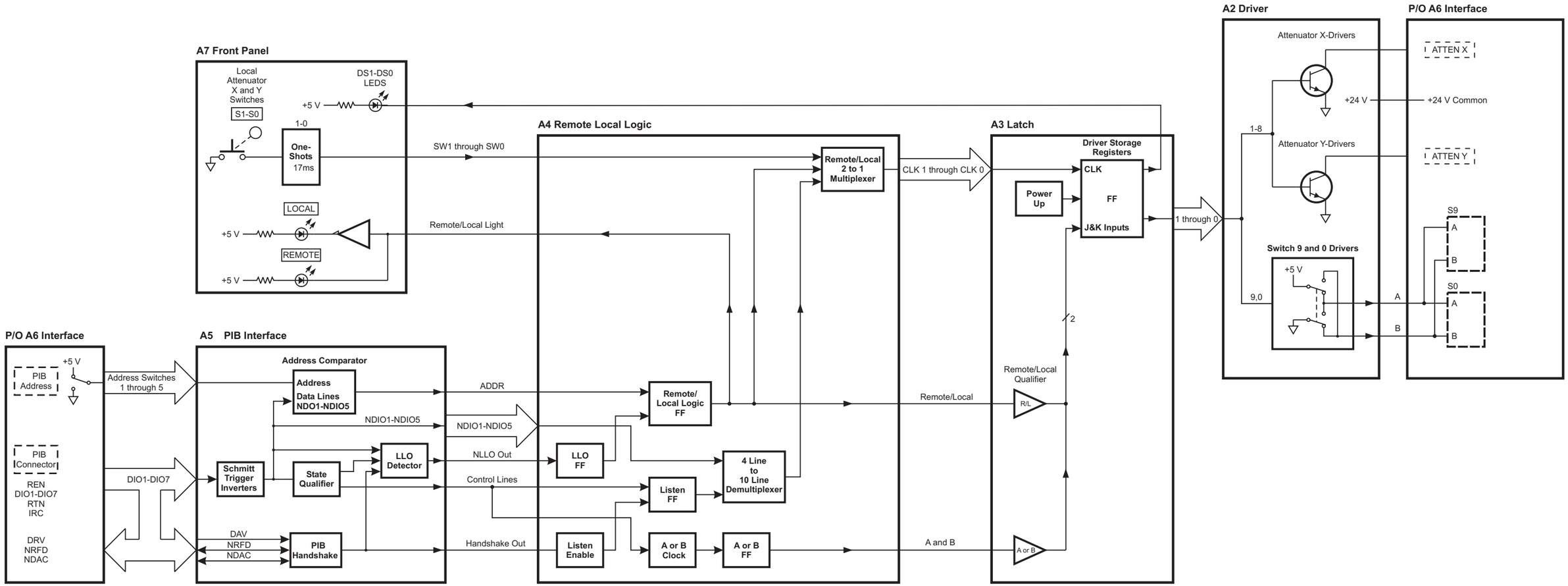

au401a

Agilent Technologies

11713A Simplified Block Diagram

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Troubleshooting the A1 Interconnect Assembly

The A1 interconnect assembly contains the power supply and connectors for other major assemblies.

To Troubleshoot the A1 Interconnect Assembly

1. Pull out the A2 driver, A3 latch, A4 remote local logic, and A5 GPIB board assemblies.
2. Turn the power on, and measure the voltage at TP1 on the A1 interconnect assembly. 5 Vdc ± 5% should be present.
3. Measure the voltage at TP2. 24 Vdc.± 5% should be present.
4. If either voltage is not acceptable, disconnect both ribbon cables to the front and rear panels and remeasure the voltages at TP1 and TP2.
5. If the voltages at the test points are still unacceptable, replace the Al interconnect assembly.

Assembly Overview

The power supply is enabled when the LINE ON/OFF switch is set to the ON position. The power supply provides +5 Vdc for the logic circuits, and +24 Vdc at 0.650 amperes continuous to drive attenuators, relays, or switches connected to the driver.

A "crowbar" circuit is incorporated that causes the primary line fuse to blow if the ac input voltage exceeds the ratings on the power mains fine module.

In addition, the Al interconnect assembly provides GPIB lines level shifting to meet the IEEE specifications for a listener device.

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Troubleshooting the A2 Driver Assembly

The A2 driver assembly is controlled by inputs from the A3 latch assembly which is clocked by either the A7 front panel switches or from the GPIB through the A4 remote local logic assembly.

To Troubleshoot the A2 Driver Assembly

1. To determine the problem board assembly, test them in the following sequence: A1 interconnect, A7 switch, A5 GPIB, A4 remote local logic, A3 latch, and A2 driver.
2. If all the other board assemblies are in working condition, do the following:
   a. Turn the power off.
   b. Open the top cover.
   c. Pull out the A2 driver assembly and check the board and its socket for damage.
   d. Reinstall the board carefully.
   e. Switch the power on.
   f. Manually press the attenuator buttons several times. The light should come on/off each time that a button is activated.
3. If the manual verification is satisfactory, check the computer-controlled remote operation by sending these commands.

Command	Desired Outcome
`OUTPUT 728;"A12345678"`	All attenuator lights go on except the local light
`OUTPUT 728;"BI2345678"`	All attenuator lights go off except the remote light.

4. If the response s satisfactory, the A2 drive assembly should be operational.
5. If the response is unsatisfactory, check the other assemblies first before you decide to replace the A2 driver assembly.

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Assembly Overview

The A2 driver assembly contains eight pairs of driver transistors and two driver relays.

One transistor of each pair, for example, Q9 and Q18, is in saturation while the other transistor is in cutoff. The saturated transistor sinks current from the + 24 Vdc supply through the load connected to the rear panel of the driver and returns it to ground. The open collector outputs are protected against spikes from inductive loads with clamp diodes to both ground and the + 24 Vdc supply. The driver transistors each have a metal tab that is attached to a common heat sink.

The relays K1 and K2 provide reversible polarity for ground and + 24 Vdc necessary to drive switches. The relay contacts are also protected against spikes from inductive loads.

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Troubleshooting the A3 Latch Assembly

The A3 latch assembly contains 10 J-K flip-flops and a power-up circuit.

To Troubleshoot the A3 Latch Assembly

1. If any of the following conditions cannot be met, replace the A3 latch assembly.
   a. Turn the power off and then turn it on again. All attenuator lights and the local light should be on.
   b. Press each attenuator switch. Only the corresponding light should turn off. No other light should flicker or change status.
   c. Send a remote command to turn the attenuators off and then on. All attenuators should come on.
   d. Send a remote command to individually control each light OFF/ON. Only the corresponding light should turn off. No other fight should flicker or change status.
2. If these tests are inconclusive, test the Al interconnect, A7 switch, AS GPIB, and A4 remote local logic board assemblies in this sequence before replacing the A3 latch assembly.

Assembly Overview

When the driver is in the local mode, the J and K inputs to all ten flip-flops are in the logic high state. The flip-flops then operate as "toggle" flip-flops and respond to the front panel pushbuttons. The pushbuttons function as clock pulses for the flip-flops.

In the remote state, the A4 assembly A or B flip-flop controls the J, K inputs. In the A state, the J inputs are in the logic low state and the K inputs are logic high.

The decoder on the A4 assembly generates the clock pulses for each flip-flop. In the A state, flip-flops 1 through 10 are set so the Q = 1 and NQ = 0. In the B state J inputs = 1 and K inputs = 0. Clock impulses from the decoder set flip-flops 1 through 10 on the negative edge as commanded by the bus.

The power-up circuit sets the state of all flip-flops so that the instrument powers up in the local state and with all switches set to the A (LEDs on) condition. Any attenuators connected to the driver are set to maximum attenuation on power up.

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Troubleshooting the A4 Local Logic Assembly

The A4 local logic assembly contains a remote/local flip-flop, an A or B flip-flop, a four-line to ten-line decoder, a local lockout flip-flop, listen flip-flop, 10 two-line to one-line multiplexers, and the required circuitry to generate a clock signal to control the operation of the four- to ten-line decoder.

To Troubleshoot the A4 Local Logic Assembly

1. Make sure that the A3 latch, A5 GPIB, and A7 switch board assemblies are functioning properly before troubleshooting the A4 local logic assembly.
2. If any of the following conditions cannot be met, replace the A4 local logic assembly.
   a. Turn the driver off and then on. The local light should be on. The local light should be on.
   b. To check the driver in remote operation, use an appropriate controller to execute the following commands.

Command	Desired Outcome
`REMOTE 728`[a]	The remote light is on and the local light off.
`LOCKOUT 7`	Press the local button. Nothing happens. The local operation is locked out.
`LOCAL 7`	The local button regains control.
`OUTPUT 728;"Al2345678"`	All attenuator lights should be on.
`OUTPUT 728;"B12345678"`	All attenuator lights should go off.

a. Factory preset GPIB address

Assembly Overview

The remote/local flip-flop is programmed through the GPIB circuitry on the A5 handshake and data input assembly. If the local lockout flip-flop is set to a high, the remote local flip-flop cannot be set to local via the A7 front panel LOCAL pushbutton. In all other cases the A7 local pushbutton will set the instrument to local.

In local operation, the 10 two-line to one-line multiplexers are set to propagate and invert the outputs of the monostable multivibrators from the A7 front panel assembly. The outputs become the clocks for the A3 latch assembly flip-flops. Bus commands determine the state of the A or B flip-flop which controls the output state of the instrument.

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Troubleshooting the A5 Handshake and Data Input Assembly

The A5 handshake and data input assembly provides the interface between the bus and the driver.

To Troubleshoot the A5 Handshake and Data Input Assembly

1. Make sure that the A4 remote local logic, A3 latch, and A2 driver assemblies are functioning properly and that the A6 interface connections are correct before troubleshooting the A5 handshake and data input assembly.
2. If any of the following conditions cannot be met, replace the A4 local logic assembly.
   a. Turn the driver off and then on. The local light must be on. The local light must be on.
   b. To check the driver in remote operation, use an appropriate controller to execute the following commands.

Command	Desired Outcome
`REMOTE 728`[a]	The remote light is on and the local light off.
`LOCKOUT 7`	Press the local button. Nothing happens. The local operation is locked out.
`LOCAL 7`	All attenuator lights go on.
`OUTPUT 728;"A12345678"`	All attenuator lights go on.
`OUTPUT 728;"Bl2345678"`	All attenuator lights go off.

a. Factory preset GPIB address

Assembly Overview

The three-wire handshake lines to the handshake logic circuits synchronize the operation of the driver remote operation. The lines are ready for data (NRFD), data valid (DV), and data accepted (NDAC).

The handshake logic processes the DAV signal and produces the handshake out (FIS OUT) signal passed to the bus logic and the local lockout logic. The DAV signal and the handshake enable (HS ENABLE) signal combine to output the NRFD and NDAC signals on the bus. The basic purpose of this logic is to signal the other driver circuits that the DIO lines contain a character for possible processing to interface the circuits to the GPIB three-wire handshake system.

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The bus logic performs the following functions:

- accepts inputs from the data input/output (DIO) lines and the attention (ATN) signal from the interface bus. These inputs, in conjunction with the HS OUT signal, enable the remote/local logic and the local lockout logic.
- processes the attenuator/switch state codes and select codes present on the DIO lines. It then combines them with handshake out (HS OUT) and remote signals to output the NCLK signal from U11A on the A4 remote /local assembly.
- places the driver into remote operation or local operation on command from the interface bus in conjunction with the remote/local logic.

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Troubleshooting the A6 Interface Assembly

The A6 interface assembly contains the GPIB address switch, the connectors for the X and Y attenuators, and the wiring for switch outputs 9 and 0.

To Troubleshoot the A6 Interface Assembly

1. To test the circuitry of the A6 interface assembly, check the driver both in manual and remote operation.
   a. Manually press the attenuator buttons several times. The light should come on/off each time that a button is activated.
   b. If the manual verification is satisfactory, check the computer-controlled remote operation by sending these commands.

Command	Desired Outcome
`OUTPUT 728;"Al2345678"`	All attenuator lights go on except the local light.
`OUTPUT 728;"Bl2345678"`	All attenuator lights go off except the remote light.

2. If the response is satisfactory, the A6 interface assembly should be operational.
3. If the response is unsatisfactory, refer to the troubleshooting procedures for the A2 driver assembly.

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Troubleshooting the A7 Switch Board Assembly

The A7 switch board assembly (front panel) consists of 10 non-retriggerable monostable multivibrators.

To Troubleshoot the A7 Switch Board Assembly

1. Check both manual and remote operation.

   a. To check the driver in manual operation, turn the driver off and then on. All attenuator lights and the local light should be on.

   b. To check the driver in remote operation, use an appropriate controller program to execute the following commands:

Command	Desired Outcome
`OUTPUT 728;"Al2345678"`	All attenuator lights go on except the local light.
`OUTPUT 728;"Bl2345678"`	All attenuator lights go off except the remote light.

2. If a function cannot be performed both manually and remotely, there may be an open line between the attenuator switch on the A7 switch assembly through the A1 interconnect/power supply and to the A3 latch assembly. To help pin point the problem, use the block diagram on page 8-11 to further trace the circuitry.

Assembly Overview

The resistor connected to the +5 volts keeps the input to the multivibrators at a logic high. The voltage across the input capacitor is 0 volts when the front panel pushbutton switches are open.

When a button is pressed, the input voltage on the one shot instantaneously drops to 0 volts and starts the output pulse. The output pulse width is controlled by a resistor and capacitor, for example R7 and C5. Nominal pulse width is 17 ms. The pulses are sent to the local/remote multiplexers on the A4 assembly and become the clock inputs for the flip-flops on the A3 latch assembly.

LEDs behind the front panel switches indicate the present output state of the driver as seen by the flip-flops on the A3 latch assembly. The driver is in the A state when LEDs are on and in the B state when they are off.

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LOCAL and REMOTE LEDs signify the operating mode of the driver. A reset circuit clears the LOCAL-REMOTE flip-flop on the A4 remote local assembly to the local state unless the instrument is in local lockout. The ON/OFF LED is operated from the +5 Vdc supply.

In remote operation, a bus command sets the listen flip-flop to accept further bus commands. The listen flip-flop resets when a local command is given.

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The A8 power supply/line module assembly

The A8 power supply/line assembly houses the power receptacle, fuse, and voltage selector PC board.

To Troubleshoot the A8 Power Supply/Line Module Assembly

1. If the attenuator/switch driver does not power on when the line button is pressed ON, check that the fuse is good.

   The main ac line fuse is located on the rear panel in the line power module. Refer to "Fuse Removal/Replacement".

2. If the fuse is not faulty, replace the A8 power supply/line module assembly.

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